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This paper offers an historical perspective as to why teachers may be reluctant to accept new technologies, and what might persuade them to use computers in their classrooms. The analysis also suggests some methods for minimizing the inhibiting factors and maximizing the acceptance of computers in elementary and secondary school settings. Explanations for the failure to use technologies are traced to: (1) little concrete evidence of the effectiveness of the use of these media; (2) teacher resistance to change; (3) lack of training in the use of equipment; (4) lack of adequate hardware, software, and courseware; (5) the need to change teaching style to use the technology; and (6) the fact that extra time and preparation are required to use these technologies. Suggestions for overcoming these inhibiting factors include providing a specialist to consult with teachers on computer applications in the classroom, conducting training sessions for teachers on computers, and rewarding those teachers who are innovative in adapting computers to their instructional programs. Four examples of successful computer programs in elementary and secondary school environments are cited. Twenty-two references are listed. (MER)

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SECURING TEACHER ACCEPTANCE OF TECHNOLOGY

BY

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SECURING TEACHER ACCEPTANCE OF TECHNOLOGY

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When addressing the topic of securing teacher acceptance of technology in schools, a great number of educators today are talking about bringing computers and computing into the schools and this means change. Bringing computers into schools some years ago might have been considered a minor change and could have affected only a few teachers, particularly the mathematics teachers, some business teachers, and those few teachers using Computer Aided Instruction (CAI), Since CAI was too expensive for most schools. Today, however, there is a new problem. Computers pervade all aspects of our lives. Everyone in our society needs to know about computers in order to function in the society. Joseph Lipson in a 1970 report for the National Science Foundation (NSF) said, "Failure of the Federal Government to move swiftly to facilitate educational uses of the new technologies will endanger the economic and, eventually, the military security of the country. If our democratic institutions are to remain stable, we must welcome, rather than fear or ignore, the imperatives of technological change. It is unlikely that we can do this without firmly weaving advanced information technologies into the fabric of our education system."[1]

He continues by saying we need a major program to

train specialists in this area -- computer specialists and people with artistic and instructional design talent. And herein lies one of our major problems, there are not and will not in the forseeable future be sufficient trained personnel for the schools unless some near miracle occurs.[2]

Further Lipson says, "We find evidence that only with an informed public, can the nation hope to move into a computer age with the speed and sense of purpose required. The adoption of a new technology is incredibly complex. At almost every stage there is strong interaction with public attitudes and public understanding. Investments, markets, legislative positions, enrollment in courses, and selection of careers will all vary with public awareness and knowledge."[3]

Beyond consideration of these problems, the acquisition of hardware, software and courseware for use in the schools must be addressed. "The dramatic change in capability, and the cost of information and image machines will touch every aspect of our personal lives and health as a society. And science education . . . will face a unique challenge in responding to the opportunity. New knowledge and skills can be taught through new forms of learning experience. Concepts and procedures can be more effectively taught to a wide range of students."[4]

The returns are great if a real committment is made. The teachers' committment is important, but is only one part. For "the acceptance by teachers of an educational

program is a necessary precondition for its success."[5] However, "a school district must have a strong commitment from the Board of Education and the administration in order to provide the policies and resources needed to establish goals and implement systematic curriculum change."[6] Does this commitment exist to allow teachers to incorporate the needed technological change?

There are several aspects that must be examined with regard to teacher acceptance of technology in the schools. It seems appropriate to consider the reasons that teachers may not accept technology, the reasons that will persuade teachers to use technology, and finally to look at the methods and means that may minimize those factors which inhibit the use of technology and those that maximize the acceptance of such technology. Before examining these factors a brief look at history seems appropriate.

Historically there has been only minimal acceptance of technology and innovation in schools. There has actually been only incremental change when the long term is considered. Today there is still a great deal of teacher explanation (lecture presentation), student listening, students doing assignments and reading from textbooks, and students writing examinations about the material presented to them.[7] That is, there is great reliance on lecture, text, and test. This is not to say that there has not been considerable emphasis at times on the use of media other than blackboard,

chalk, and textbooks, but these older materials remain dominant in the majority of classrooms. Dr. Andrew Molnar cites a 1975 National Science Board report stating, "that over half of all science and social studies and two-thirds of all mathematics classes use a single textbook and many teachers use no supplementary aids other than the chalkboard."[8] The question is why is this so? Why are television teaching, programmed learning materials, films, direct-dial access systems, and language laboratories not more dominant? There is no single answer. Some of the explanations for the failure to use these technologies in schools include: little concrete evidence of the effectiveness of the use of these media, teacher resistance to change, lack of training in the use of equipment, the lack of adequate hardware, software and courseware, the need to change teaching style to use the technology, and the fact that extra time and preparation are required to use these technologies. Acceptance, on the other hand, occurs when the teacher feels that the technology is effective with students, the teacher has adequate training to effectively and efficiently use the technology, there is adequate hardware, software and courseware, and the technology fits the teaching style of the teacher.

Almost parenthetically it seems appropriate to mention that one of the technologies that has succeeded is the language laboratory. Here the special feature seems to be the active rather than passive involvement of the learner.[9]

This and the experience of most teachers seems to agree that active involvement of the learner in the learning process is more effective than passive involvement.

The primary factor most teachers consider in relation to the use of technology in the classroom is its effectiveness in the teaching-learning environment. Nearly all technology will require an investment of time and effort on the part of the teacher, if they are to use it in their classroom. Unless the teacher is thoroughly convinced that this is worthwhile for the students, the teacher will not be motivated to expend time and/or effort in preparing for the use of the technology.

Today, the technology that seems paramount in the minds of most educators is computers, more particularly microcomputers, and micorcomputers with videodisks. In terms of schools this is a very recent development. Computers were unheard of in the schools in 1950. Indeed, there were only 15 computers in the United States in 1950[10] and in 1951 the first commercial computer, a UNIVAC, was delivered to the Census Bureau.[11] It was 1954 before a commercial computer was delivered to other than a governmental agency. But computer technology developed rapidly and by the late fifties there were already many "second generation" computers.[12] These computers were more reliable, faster and less expensive. At that time many schools acquired their first computers, business and industry recognized the need for computer specialists, and the general interest in

this new technology spurred the development of courses in programming and the use of the computer. A few experimental programs were developed in the late fifties and a scattering of credit and non-credit courses appeared at various educational levels. The problems of the emerging new discipline were apparent from the beginning -- equipment, teaching staff, texts and curricula.[13]

On the secondary level a pilot program in Livermore, California in 1957-58 was one of the earliest reported courses.[14] This successful program led to the introduction of a regular course in computer programming in 1958. Designed for mathematics and science students, the purpose was enlightenment and enrichment of their programs. Local business and industry provided computer facilities, materials, and instructors. It should be noted that this was one of the few areas of the country where firms had computers at this early date and where they were willing to donate so generously of their time, facilities and personnel. This cooperation between school and industry was present in the early states of many programs.[15]

Until the mid-sixties progress was slow. In 1963 the PIP Newsletter listed all the courses and programs known to the Project on Information Processing, a committee of the National Science Teachers Association. The report showed that only a scattering of courses were being offered. There was evidence of a lack of equipment and of trained personnel

for teaching. The lists of available texts and visual aids revealed a dirth of suitable materials. Many non-credit courses were offered by business and professional associations[16] for the enrichment of the regular high school program. Significantly, two distinct varieties of programs were reported, the one with a mathematical - scientific orientation and the other with a business orientation. Hard facts as to the number of secondary schools teaching data processing are not available, but one estimate is that in 1966 one-fifth of all high schools had access to data processing equipment for instructional purposes, though most of the equipment was unit record equipment.[17] Another report at that time indicated that nationwide about 400 secondary schools were using computers for programming scientific problems.[18] Throughout the sixties the problems were still equipment, teachers, texts, and curricula. But some schools were finding solutions.[19] Time-sharing services provided the equipment at a price many could afford. Some teachers obtained training at local colleges or attended summer institutes sponsored by the National Science Foundation. Some texts were appearing, though not always of good quality, and the results of experimental and early course offerings of a few schools provided the basis for curriculum development.

The situation as the seventies began is well summarized by Warren Stenberg of the University of Minnesota:

> Computer science courses have not as yet played a major role in computer use at the secondary scene but they now seem to be coming up fast . . . . (Even though) no standard curriculum has yet been developed . . . (and) textbooks are not generally used.[20]

Courses in data processing "are still in the category of pipe dreams since the teaching personnel just does not exist."[21]

But events in the seventies changed this picture. Today there is a sudden increase in the number of schools across the nation which are beginning to use computers or are considering the use of computers in the classroom. There are two major forces behind this movement. First, computers are, with the advent of the microcomputer, relatively inexpensive. Second, the computer has become such a pervasive factor in our daily lives that nearly every citizen must have some knowledge of computers to function in a society where they will interact, directly or indirectly, with computers.

Surveys of teachers indicate that most teachers believe that all students should learn about the computer. Not all teachers are convinced that they should use computers in their own classrooms, and some of those who are not interested in using computers indicate that they are unaware of the possible uses of the computer in the classroom.[22]

Other factors which cause teachers to be reluctant to use computers include earlier claims that the computer will replace the teacher, their own lack of knowledge about computers, the feeling that computers will deliver a less personalized education for the student, a lack of understanding of the advantages and modes of use of computers in the classroom, being ill-at-ease when using computers, and having seen examples of problems with the use of computers in various school administration applications.

For those teachers who are convinced that computers are an important part of the classroom, there may remain some reluctance to use computers. This reluctance comes from anxiety in dealing with equipment, a feeling of loss of control of the teaching-learning situation, inadequate hardware, software, courseware, and support, or because of the considerable time and effort required to obtain adequate training, to remain current in the field and to use computers in appropriate ways in the classroom.

What Will Persuade Teachers to Use Computers?

First appropriate training is essential. Through pre-service, in-service and professional development the leaders in education need to see that teachers understand that the computer is to be viewed not as a replacement of the teacher, but rather as a sophisticated tool to be used by the teacher to allow the teacher to do a better job in the classroom.

This means that teachers must realize the potential of the computer in the classroom, that the computer can be used in many modes, as a tutor to provide information and drill and practice, as a tool in courses that require a calculator or information retrieval device, and as a machine to be instructed. Teachers should be given ample opportunity to see computers used in all these ways and to see how they may effectively be used in their own classroom. Seeing examples of quality uses of computers should allay misgivings and motivate teachers to consider using computers in their own classrooms.

Second, adequate hardware, software and support must be assured. At the present time many schools face tight budgets and this naturally means strict limitations on funds for hardware, software and support. There are areas which are trying innovative programs for the use of computers through sharing of facilities, one school using the microcomputer for a few weeks and then passing it on to another school. This is certainly preferable to no computer at all, but is far from adequate. While research supports the use of one microcomputer or terminal by a pair of students at one time,[23] in a classroom of twenty to thirty students, one computer means that the teacher cannot help the students using the computer and neglect the vast majority of the students in the room. Ideally, a computer for every four students is suggested. A single laboratory in the school, where students may go to use the computer, might be a good solution. The teacher could accompany the students and

various classes could be scheduled to use the laboratory, or the laboratory might function in much the same way as the library. Even now it is being suggested at Carnegie Mellon University that each student should have his/her own microcomputer.[24] This is certainly a long way off for public secondary schools, but gives some idea of the thinking of some professional educators about the importance of computers for students.

Software is beginning to be developed for use in schools. At the present time much of the software that is being used has been developed by the teachers who are using it, or has been given to them by friends and acquaintances, or swapped through user's groups. A current project of the North West Regional Laboratory in Portland, Oregon, headed by Dr. Judith Edwards and funded by NSF, is evaluating and cataloging software for use in schools. Other materials, primarily for use in higher education, are available through CONDUIT at the University of Iowa. Several microcomputer vendors are also active in assisting in the exchange of software among their users. While there is not at the present time an abundance of software, positive steps are being taken in the development and dessimination of quality software. This is an area which needs continued attention.

There must, at least for the present, be a realization that the classroom teacher requires support in the use of a

computer or computers in the classroom. Many teachers, especially in the initial stages, are unfamiliar with computers and find such small problems as hooking up and adjusting the color monitor or TV, tightening up a connection, and checking out the machine for proper functioning, to be overwhelming. For some time after the initial introduction into the classroom the teacher needs someone to whom to turn in case of a malfunction, someone to be a resource when questions arise in the use of software and for lesson planning. This seems essential if the transition into the classroom is to be smooth. One "expert" in the school building who has the time, expertise, and assignment to assist other teachers seems to alleviate many problems.

Third, teachers must be given time for training and for planning for the use of computers. Not only is a considerable time required to obtain the necessary training to use a computer with ease in the classroom, time is also needed to remain current in this rapidly changing field. The amount and type of training that an individual teacher needs will vary considerably, depending on the previous training of the teacher and the mode and extent to which the computer is to be used in the classroom. For those teachers who will use only prewritten software, the training need not be extensive. However, for teachers who are teaching computer literacy and computer programming

much more training will be necessary and frequent updating will be necessary since the field is so dynamic.

What Can Administrators and Educational Leaders Do To Encourage The Use of Computers in Classrooms?

There are no simple answers to bringing computers into the classroom. Indeed it has been a long process and it will not occur immediately. However, it is crucial that the process of bringing computers into the classroom be addressed in this decade. Dr. Andrew Molnar of NSF sees this as a critical issue for schools. Change cannot be mandated, but leaders can persuade. This is an appropriate time because the public is aware of the importance of computers, parents are seeking, in many cases, for computers to be introduced into schools. News magazines, such as TIME, indicate that the USA is falling behind Japan in technology, particularly in computerized robots. Many leaders are pointing to the need for better science training, which means training in the use of computers. With this stiumulus, it is time to develop a plan of action which should include:

1. provide teachers with an opportunity to learn about appropriate uses of computers in the classroom.

2. provide pre-service and in-service training for teachers.

3. provide adequate, not token, equipment for the classroom.

4. provide software packages for use in classrooms.

5. provide auxiliary teaching resources -- films, texts, lesson plans, and curriculum guides.

6. provide a specialist to consult with classroom teachers concerning hardware, software and classroom usage of the computer.

7. reward good teaching with computers.

8. provide examples of teachers doing superior teaching with computers.

Though this list seems long, and some items involve considerable expense, we must consider the cost of not providing these items for our teachers and students. Because "the computer has, today, had an impact on the lives of each and every one of us; already, most of our financial affairs and many of our social affairs are subtly controlled or structured by the computer, and the future promises only more of the same,"[25] we must see that every student has a "basic understanding of the computer . . . a critical component of the knowledge of any educated man or woman."[26]

We must realize that the status of computer literacy among the students in our schools today is woefully low. Dr. Ronald E. Anderson of the Minnesota Educational Computing Consortium (MECC) reported in December 1980 at the National Computer Literacy Goals for 1985 Conference in Reston, Virginia that:

> In brief, the best data we have suggest that few students in either senior or junior high school have opportunities for computer experience; few have algorithmic problem-solving skills; and many lack an awareness of the role and value of computers. Since these findings are true for 17 year old students, most of whom were in 11th grade, we would speculate that many students graduating from high school and perhaps from college without a minimal level of computer literacy.

> What is equally disturbing is the evidence in the data that what little literacy exists in the nations' students in unequally distributed across social groups. Computer experience is must less common among minorities, women, and those living in the Southeastern U.S. or in rural areas. Not only is computer experience less common among these groups but there is good evidence that computer knowledge and skills are lower as well.[26]

All students must become computer literate. We must see to it that computer education is equitable and that we do not develop a group that is information and computation rich and a group that is information and computation poor. For information and computational ability are power and these belong to all.

Finally, it is instructive to look at some examples of computers in schools and to try to determine how they came about and why they succeeded. There are many examples that should be considered and here only a few are mentioned. One of the earliest known programs in a public school was in Livermore, California in 1957. Here parents wanted their children to learn about computers and programming. Some of the parents and local professionals taught the course and the programs were taken to local facilities to be run. There are many similar examples of parents teaching a course or courses, providing access to equipment and giving excellent support to the classroom teacher. A program of this type can work in the initial phases, but eventually it must become a regular part of the curriculum and be handled by a regular teacher.

One of the important examples of an entire state taking the initiative in bringing computing into the schools is in Minnesota. The Minnesota Educational Computing Consortium has been very successful in this respect. They began by using a system of time-shared computers with terminals in the schools and now are also using microcomputers. They provide teaching training, software, group purchase of hardware, curriculum guidelines and support. State and local school systems in other areas can gain considerable expertise from the publications of MECC. You will be able to earn more about this in the next session when Dr. John Haugo, Director of MECC, talks in the session "Managing Technological Change in the Schools".

The impressive work in the Philadelphia Public Schools under the direction of Ms. Sylvia Charp is an excellent example on a local level. People from around the world visit this project and emulate many of the fine parts of this program.

Many of the secondary schools in New England owe much of their success to Dartmouth College which not only made computer resources available to these schools through their time-sharing system, but Dartmouth also trained teachers and encouraged the development and exchange of software.

The early and successful programs in computing in Oregon owe much to Dr. David Moursund who obtained NSF

grants to fund summer training sessions for secondary school teachers at the University of Oregon. An outgrowth of this was the establishment of the Oregon Council on Computer Education and the publication The Oregon Computing Teacher which has recently become The Computing Teacher and is distributed nationally.

These are but a few of the projects that have had an effect on the local or state schools, but they are important and we can learn much from them. In every case there was at least one very dedicated individual who gave guidance to the project, there was training of teachers, there was involvement in acquiring of hardware, there was development and dissemination of software, and there was ongoing support for the teachers in the classroom. These are the essential ingredients to encourage teachers to use computers effectively in their classrooms.

FOOTNOTES

[1]Joseph I. Lipson, "Technology Program Recommendations," Technology in Science Education: The Next 10 Years (Report for NSF, July 1979, (SE-79-57)), p. 32.

[2]Peter J. Denning, "U.S. Productivity in Crisis," Communications of ACM (November, 1980), pp. 617-619.

[3]Lipson, p. 33.

[4]Lipson, pp. 35-36.

[5]Mario Leyton Soto, "Teachers, Parents and Community Data Sources," Handbook of Curriculum Evaluation. Arieh Lewy (ed.) (New York: Longman, Inc., 1977), p. 252.

[6]Beverly Hunter, An Approach to Integrating Computer Literacy Into the K - 8 Curriculum (Alexandria, Virginia: HumRRo, 1980), p. 8.

[7]A. E. Conord, "How the Computer Can Bring Teacher and Student Closer Together," AEDS Journal, Fall, 1973), pp. 11-12.

[8]Andrew Molnar, "The Next Great Crisis in American Education: Computer Literacy," AEDS Journal, (Fall, 1978), p. 12.

[9]A. Kent Morton, "Provoking Educational Change Within Existing Academic Structures," AEDS Journal, (Spring, 1975), pp. 79-81.

[10]Eric A. Weiss (ed.), Computer Usage/Fundamentals (New York: McGraw-Hill, Inc., 1969), p. 10.

[11]Richard N. Schmidt and William E. Meyers, Introduction to Computer Science and Data Processing (New York: Holt, Rinehart, and Winston, Inc., 1965), p. 25.

[12]Carl Feingold, Introduction to Data Processing, Dubuque, Iowa: William C. Brown Company Publishers, 1971), pp. 26-27.

[13]Ibid, pp. 26-27.

[14]Howard E. Tompkins, "Computer Education," in Advances in Computers, (eds.) Franz L. Alt and Morris Rubinoff (New York: Academic Press, 1963), Vol. 4, pp. 135-168.

[15]Darrel G. Littlefield, "Computer Programming for High Schools and Junior Colleges," in The Mathematics Teacher, LIV (April, 1961), pp. 220-223.

[16]Reports of experimental programs appear in several sources. See particularly PIP Newsletter, 1963-1965. Curricula for programs at all levels exist in fair abundance in several volumes of AFIPS Conference Proceedings and SIGCSE Bulletin. Many articles from these sources were compared to formulate the statements of this paper.

[17]George C. Heller, "A Computer Curriculum for the High School," Datamation, VIII (May, 1962), pp. 23-26.

[18]C. B. S. Grant, "Data Processing Instruction Predicted for Most High Schools Within 5 Years," Business Automation, XIV (September, 1967), pp. 36-37.

[19]Charles H. McCoach, "Computers in the Classroom," Software Age, III (April, 1969), p. 44.

[20]Warren Stenberg, "Computing in the High Schools -- Past, Present and Future -- and Its Unreasonable Effectiveness in the Teaching of Mathematics," AFIPS Conference Proceedings, XL (Montvale, New Jersey: AFIPS Press, 1972), p. 1052.

[21]Ibid., p. 1052

[22]Dorothy Jo Stevens, "How Educators Perceive Computers in the Classroom" AEDS Journal (Spring, 1980) pp. 221-232.

[23]Doris K. Lidtke, "Paired and Individual Learning in Computer Programming: An Evaluation of Student Achievement and Cost Effectiveness," Unpublished doctoral dissertation, University of Oregon, 1979.

[24]Jack Magarrell, "Universal Access to Personal Computers is Urged for College Students, Professors," Chronicle of Higher Education, (January, 1981) pp. 1, 14.

[25]William S. Davis and Allison McCormack, The Information Age (Reading, MA: Addison-Wesley Publishing Company, 1979) p. 15.

[26]Ronald E. Anderson "National Computer Literacy, 1985," A paper presented at the "National Computer Literacy Goals for 1985," Reston, Virginia, December 18-20, 1980.